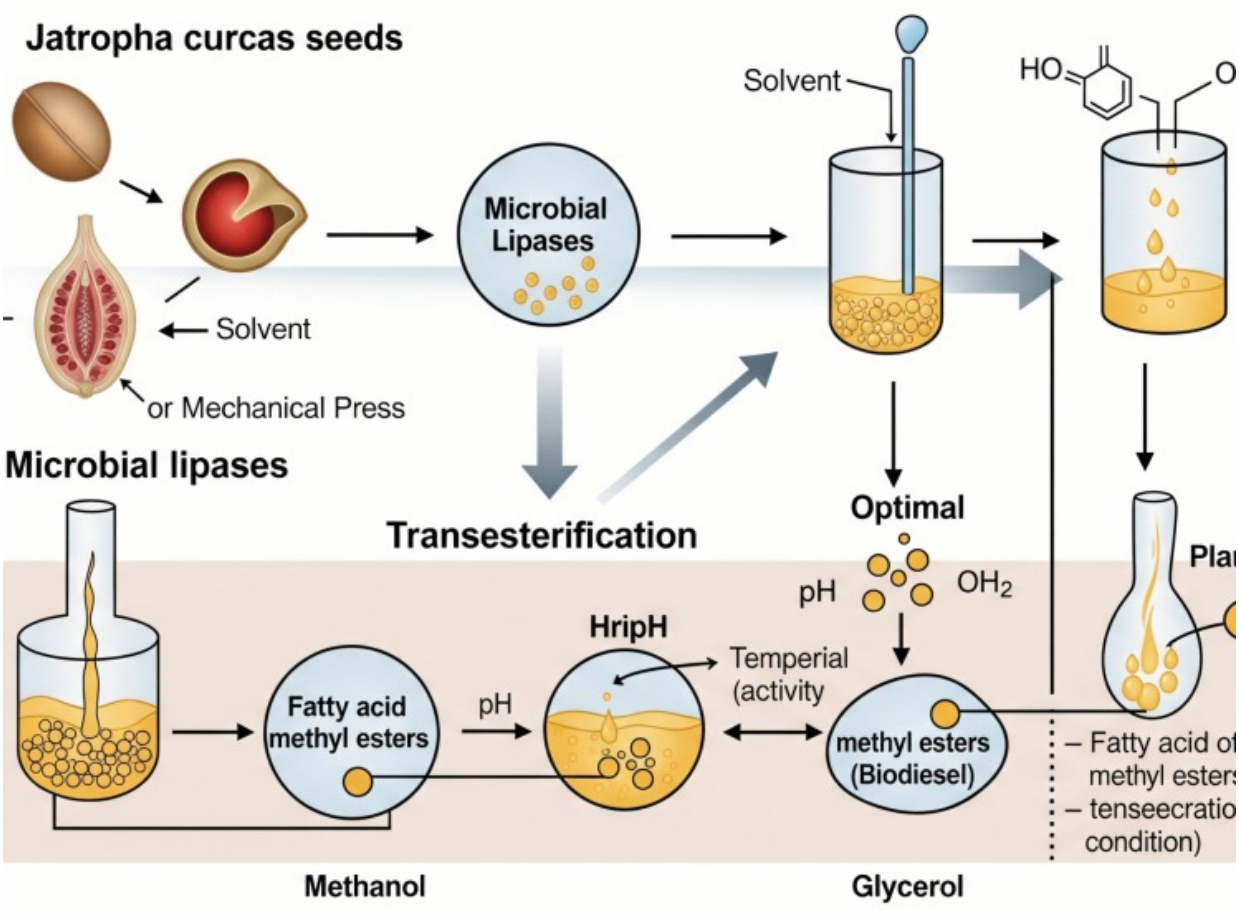
How Indigenous Bacteria Help Turn Jatropha Seeds into High-Yield Biodiesel



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Introduction

An introduction to the topic "How Indigenous Bacteria Help Turn Jatropha Seeds into High-Yield Biodiesel" The global demand for sustainable and renewable energy has sparked interest in biodiesel derived from non-edible plant sources. Among them, *Jatropha curcas* stands out due to its resilience, oil-rich seeds, and minimal competition with food crops. A promising approach involves using lipase-producing bacteria from oil-contaminated soils to catalyze the conversion of *Jatropha* seed oil into biodiesel.

This blog post explores the scientific breakthrough in optimizing biodiesel yield through biological transesterification. Researchers, scientists, and sustainable energy entrepreneurs will gain insight into an environmentally friendly alternative to fossil fuels that aligns with ASTM and EN fuel standards.

Whether you're a bioenergy researcher or simply interested in green technology, this post delivers practical and research-backed content.

Excerpt from the Thesis

> ### *Lipase Mediated Biodiesel Production from Jatropha curcas Seed Oil Using Indigenous Bacteria of Oil Contaminated Soil*
>
> #### *8.1 Abstract*
> *"Biodiesel production from non-edible feedstocks, such as Jatropha curcas, by lipase producing bacteria is considered a sustainable measure to reduce food versus fuel competition and dependency on fossil fuels. In the current study, lipase producing bacterial strains were isolated from oil-contaminated soil, followed by their biochemical & molecular identification and determination of their capacity to produce biodiesel from J. curcas seed oil.*

Plackett-Burman and central composite designs were used to optimize various factors during whole cell based transesterification of J. curcas seed oil.

The highest volumetric yield of biodiesel (~97%) was obtained by using Brevibacterium SB11 MH715025 and Pseudomonas SB15 MH715026, strains. With the most optimum biodiesel yield at 37°C, oil to methanol molar ratio of 1:9 and agitation (100 rpm); Pseudomonas SB15 MH715026 was identified as the most potent strain.

Confirmation of fatty acid methyl esters was done through fourier transform infrared spectroscopy having infrared spectra in ranges 1735–1750 at cm^{-1} and 1300–1000 cm^{-1} that corresponds to C=O and C–O functional groups present in biodiesel esters, respectively.

The quality of biodiesel was evaluated and the qualitative fuel properties determined for acid value, pour point, cloud point, peroxide value, boiling point and specific gravity were 0.44±0.1 mg potassium hydroxide (KOH)/g, 3±0.1 °C, 4.1±0.4 °C, 1.41±0.1 milli equivalent (Meq) O_2/kg, 260±1 °C and 0.87±0.02 kg/m^3, respectively.

The fuel properties of biodiesel produced by the selected strains were found in line with quality standards specified by ASTM D6751 and EN-14103."

8.2 Introduction

"Biodiesel, a mixture of mono-alkyl esters of fatty acids, has gained a global attention as a renewable energy fuel. A number of edible and non-edible feedstocks have been used for biodiesel production.

Although the edible feedstocks, especially, vegetable oils such as palm, sweet basil, soybean and rapeseed oils have been extensively used for biodiesel production and dominated the global biodiesel market, but the food versus fuel competition due to the use of edible feedstocks has raised questions that alternatively strengthened.

This promoted the focus on non-edible feedstocks for biodiesel production.

Use of a number of non-edible feedstocks have been reported for biofuel production such as Jatropha curcas, Pongamia pinnata, Azadirachta indica, Castor oil plant and Simarouba glauca.

Among these Jatropha curcas has been found the most prominent plant for biodiesel production. The oil content of J. curcas seed kernel ranges from 40–60% and can be converted to biodiesel either chemically or enzymatically.

The use of enzymes (lipases) as biocatalysts in transesterification reactions has gained attention due to their environmentally benign and specific catalytic activity. Moreover, lipase catalyzed reactions can be carried out under mild temperature and pressure without the need of purification of feedstock oils.

The major drawback of enzymatic transesterification process is the high cost of enzymes. Whole cell biocatalysis offers an alternative approach to enzyme utilization in biodiesel production as it avoids complex downstream processing and cost associated with enzyme purification.

In the current study, oil contaminated soil samples were collected and screened for isolation of potential lipase producing bacterial strains. The selected strains were subjected to biochemical and molecular identification.

The transesterification reaction parameters (temperature, oil to methanol ratio and agitation) were optimized using statistical design approach. Fourier transform infrared spectroscopy (FTIR) was employed for biodiesel confirmation and fuel properties were analyzed in accordance with ASTM D6751 and EN-14103 fuel standards."

Source Citation

Researcher: Abdul Haq
Thesis Title: *Biotechnological Applications of Jatropha curcas Seeds for Bioenergy Carriers and Bioactive Compounds*
Supervisor: Dr. Malik Badshah
University: Quaid-i-Azam University, Islamabad

Year of Completion: 2020
Exit Page Number: 191

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